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**SPECIES OF THE *HAZELAE* GROUP OF *PLATYMANTIS*
(AMPHIBIA: RANIDAE) FROM THE PHILIPPINES, WITH
DESCRIPTIONS OF TWO NEW SPECIES**

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Three species Groups of Philippine anurans of the genus *Platymantis* are recognized. The Groups are diagnosed on the basis of combinations of digital characters. Species of the *hazelae* Group are revised. Eight species are placed in this Group, two of them (*reticulatus* and *panayensis*) previously undescribed. These small to moderate-sized (20–30 mm for males and 25–39 mm for females) frogs are forest species from mountain areas of islands in the Greater Negros and Greater Luzon island groups.

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The genus *Platymantis*, as it is currently diagnosed, has two centers of diversity, one in the Philippine Islands and one in the Bismarck-Solomon Islands. There are three small extensions beyond these archipelagos. New Guinea has three species, Fiji two species, and the Palau Islands one species. The relationships of the three Philippine Groups, recognized in this study, to each other and to the Groups that apparently exist in other parts of the range of the genus are unclear at this time. Phylogenetic studies of the Asiatic island ranids currently underway may provide some answers.

The latest revision of Philippine *Platymantis* is that of Inger (1954). He followed Taylor (1920) in assigning both the large-disked and small-disked species to one genus, whereas Boulenger (1918) and Noble (1931) had placed these assemblages in two genera (*Cornufer* and *Platymantis*). Inger (1954) regarded disk size as simply a measure of the degree of specialization of these structures representing a continuum.

Inger recognized seven Philippine species, five with broadly dilated finger disks and two without or with small finger disks. Since 1954, five more Philippine species have been described. Of these

ingeri, *insulatus*, and *lawtoni* have large finger disks; *levigatus* and *spelaeus* have small to moderate disks.

When a combination of digital characters and size of finger disks are considered, it becomes evident that three species Groups are represented in the Philippine fauna. Species of the *hazelae* Group are the subject of this paper.

MATERIALS AND METHODS

Materials examined include: (1) all earlier reported specimens including types of previously described species and (2) all specimens of large-disked species in the recent samples of populations from the northern and central islands. These collections are in the California Academy of Sciences (CAS or CAS-SU), Cincinnati Museum of Natural History (CMNH), Field Museum of Natural History (FMNH), Museum of Comparative Zoology (MCZ), United States National Museum (USNM), and Philippine National Museum (PNM).

Morphometric characters, including snout-vent length (SVL), head length (HL), head breadth (HW), snout length (SnL), horizontal diameter of eye (ED), horizontal diameter of tympanum (TD), tibia length (TiL), third finger length from proximal edge of basal tubercle (3FL), diameter of third finger disk (3FD), and diameter of third toe disk (3ToD) were measured to the nearest 0.1 mm using a Helios dial caliper. The significance of differences between means (\bar{x}) of various proportional measurements is based on Student's *t* tests. Only adult specimens were used on the assumption that growth is linear for this age class. Other non-metric, morphological characters include: webbing of fingers and toes, skin ornamentation, shape of snout, color pattern, vomerine teeth, structure of tubercles on hands and feet, shape of terminal phalanges, and shape and projection of snout. Useful characters such as vocalizations are still not available.

SYSTEMATIC SECTION

Although only the *hazelae* Group species are the subject of this study, preliminary diagnoses of the three Philippine Groups are provided.

The *hazelae* Group. — This Group is distinguished by the following combination of characters: (1) terminal phalanx a wide "T"; (2) disks of fingers, except first, broadly dilated; (3) first finger much shorter than second, not reaching beyond midpoint between subarticular tubercle and disk; (4) digits proximal to disks much broader than deep, the result of wide dermal flanges (Fig. 1a); (5) subarticular tubercles large, round, and only moderately protruding (Fig. 1a); (6) toe disks smaller than finger disks.

The *guentheri* Group. — This Group is distinguished by the following combination: (1) terminal phalanx a moderate to wide "T"; (2) disks of fingers, except first; moderately to broadly dilated; (3) first finger shorter than second, reaching as far as base of disk for some species; (4) digits proximal to disks about as deep as broad (Fig. 1b), the result of narrow, dermal flanges (Fig. 1b); (5) subarticular tubercles large and strongly protruding (Fig. 1b); (6) toe disks about as broad to half as broad as finger disks.

The *dorsalis* Group. — This Group is distinguished by the following combination of characters: (1) terminal phalanx bluntly rounded to pointed; (2) tips of fingers blunt, without disks, or with small to moderate disks (Fig. 1c); (3) first finger slightly shorter, about as long as, or longer than second; (4) digits proximal to disks about as deep as broad (Fig. 1c); (5) subarticular tubercles large, strongly protruding and frequently pointed (Fig. 1c); (6) finger disks smaller than to slightly larger than toe disks.

Four of the five large-disked species recognized by Inger (1954) are assigned to the *hazelae* Group. His sample for those four species was 22 specimens: *cornutus* (one), *subterrestris* (four), *polilloensis* (six), and *hazelae* (11). *Platymantis lawtoni* Brown and Alcalá, 1974, was based on two specimens. Although the samples for some species are still small, field work during the past couple of decades by the junior authors and R. I. Crombie, L. R. Heaney, C. A. Ross, A. C. Diesmos and D. Balete has increased the sample size for the Luzon population of *montanus*, and added samples from previously unknown populations on several islands (Luzon, Masbate, Sibuyan, and Panay). It therefore is appropriate to reexamine the systematic status of these populations.

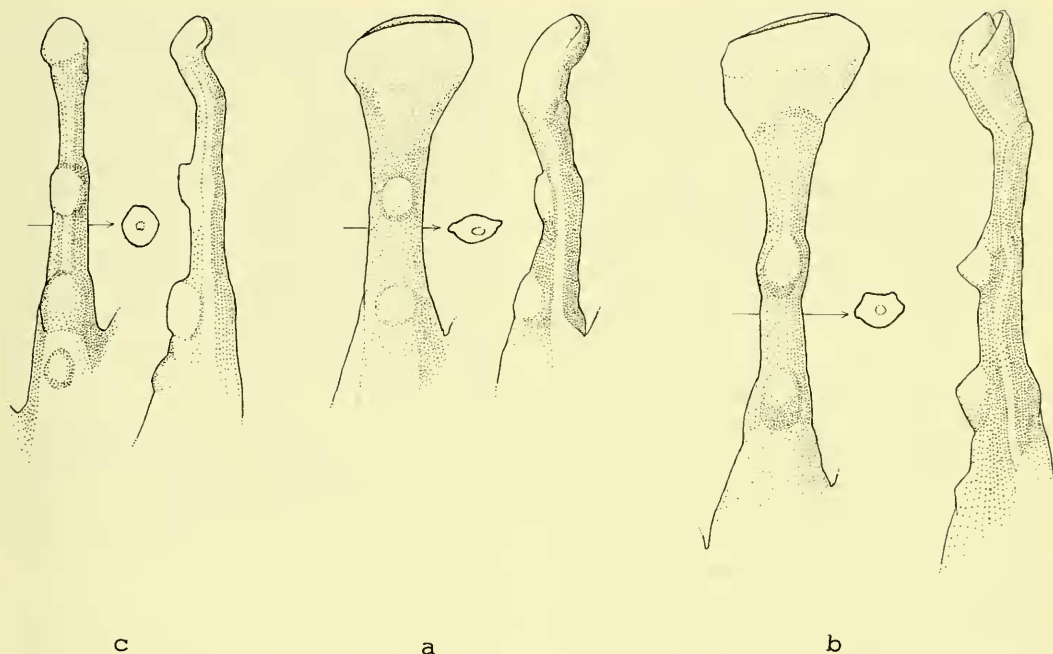


FIGURE 1. Ventral, cross-sectional, and lateral views of third finger, showing differences in disks, breadth proximal to disks, and subarticular tubercles for: a. *Platymantis hazelae* Group, b. *Platymantis guentheri* Group, and c. *Platymantis dorsalis* Group.

Key to *hazelae* Group Species

- 1a. No pale (yellow in life) and brown areolations in groin and on hind limbs; snout pointed to round-pointed; upper jaw moderately to strongly protruding 2
- 1b. Pale (yellow in life) and brown areolations in groin and on hind limbs present; snout rounded; upper jaw scarcely to moderately protruding 4
- 2a. Prominent, fleshy, triangular horn present on posterior upper eyelid. *cornutus* Taylor
- 2b. No such fleshy horn on upper eyelid ... 3
- 3a. Snout pointed, short relative to head breadth (SnL/HW 35–43%, mean 39.0); tympanum large relative to eye (TD/ED 25–42%, mean 35.55); known from Negros and Masbate islands *hazelae* Taylor
- 3b. Snout pointed, long relative to head breadth (SnL/HW 40–43%, mean 40.75); tympanum small relative to eye (TD/ED 19–40%, mean 29.0); known from Polillo Island *polilloensis* Taylor
- 4a. SVL 20–28 mm for males and 25–34 mm for females 5
- 4b. SVL greater than 28 mm for males and 35 mm for females. *lawtoni* Brown and Alcalá
- 5a. Tympanum large, TD greater than 3FD and 42–52% of ED; finger disks moderately broad (3FD 19–31% of 3FL) *subterrestris* Taylor
- 5b. Tympanum small to moderate, TD less than 3FD and 23–50% of ED; finger disks very broad (3FD 31–48% of 3FL) 6
- 6a. Pale, brown-ringed areolations present on lower hind limbs, thighs and groin; frequent mottling of irregular brown lines on belly; known only from Mt. Isarog in south-eastern Luzon *reticulatus* new species
- 6b. Pale and brown areolations rarely evident on lower hind limbs; no mottling of brown lines on belly 7
- 7a. TiL usually greater than 50% of SVL; ED usually greater than 30% of HW; known from Panay Island. *panayensis* new species
- 7b. TiL usually less than 50% of SVL; ED usually less than 30% of HW; known from mountains of southwestern Luzon Island *montanus* Taylor

Platymantis cornutus (Taylor)

Cornufer cornutus Taylor, 1922a:175 (Type loc.: Balabalan, Mountain Province, Luzon Island; holotype in CAS).

This species, described by Taylor on the basis of the unique holotype, is tentatively included in this Group. No further examples have been reported or are known to have been collected; and the condition of the type specimen does not permit x-raying for most skeletal characters that are critical for verification of the current generic assignment; although the omosternum is forked and the nasals appear to be large.

DESCRIPTION. — SVL 30.0 mm (in preserved state) for the unique type; HW 12.2 mm and HL 10.2 mm; snout rounded; SnL 4.2 mm; ED 3.5 mm; tympanum exposed; TD 1.3 mm; canthus rounded; lores moderately oblique, concave; fingers with very small webs but with flanges of skin; first finger only reaching distal edge of tubercle of second finger when adpressed; disks of fingers (except first) large and rather truncate; 3FD 2.0 mm and 3FL 5.8 mm; subarticular tubercles large, moderately protruding; one row of supernumerary tubercles; inner metacarpal tubercle moderate, middle one large, outer small; hind limbs long, TiL 14.7 mm; toes webbed to base of tubercle on inside of first and second toes, to middle of tubercle on third and fifth, short of basal tubercle on fourth; 3ToD 1.0 mm; subarticular tubercles moderately large; inner metatarsal tubercle low, elongate; outer round, pointed; no supernumerary tubercles; dorsum with only few scattered, low tubercles; prominent, triangular horn near posterior corner of eyelid; venter with some faint, flat granules posteriorly; more coarse granules on posterior thighs.

COLOR. — In life (after Taylor 1922a), "Blackish brown above with two putty-colored lines on side of back; small, scattered, greenish spots on back; spots on tympanum, loreal region, and top of head putty-colored; groin yellow; sides of body slightly yellow; upper part of femur yellowish green; throat and belly whitish; femur and tibia greenish yellow below. When preserved in alcohol the greenish spots appear dark. The spots on the tympanum, below the canthus rostralis, and on the upper lip are strongly pronounced."

In preservative, the black has faded to reddish brown and the green and yellow have faded completely.

REPRODUCTION.— No information is available for this species.

COMPARISONS.— In general appearance and the digital characters, this species is in agreement with others species of the *hazelae* Group; but the unique ornamentation, a prominent fleshy flap protruding from the upper eyelid distinguishes this species from other known species. Also the head would appear to be broader relative to its length than is characteristic of other species of this group.

ECOLOGICAL NOTE.— Taylor (1920) notes that the specimen was on a leaf of a shrub growing in a small mountain stream.

RANGE.— Known only from the type locality.

Platymantis hazelae (Taylor)

Philautus hazelae Taylor, 1920:298 (Type loc.: Mt. Canlaon, Negros; holotype in CAS).

?*Cornufer rivularis* Taylor, 1922b:270 (Type loc.: Balabalan, Mountain Prov., Luzon; holotype in CAS).

Taylor (1920) described *Philautus hazelae* from Mount Canlaon, Negros Island; (1922a) *Philautus polilloensis* from Polillo Island; and (1922b) *Cornufer rivularis* from northern Luzon Island. Inger (1954) concluded that all three species were based on populations of ranids belonging in the genus *Cornufer* (= *Platymantis*). He treated *hazelae* and *polilloensis* as valid species, based on the slightly longer, more pointed snout and possibly smaller size of the latter, but placed *rivularis* in the synonymy of *hazelae*. His samples were small: 11 specimens of *hazelae* from Negros, 3 of *rivularis* from Luzon, and 6 of *polilloensis* from Polillo. The samples of *rivularis* and *polilloensis* available at this time, are still limited to the specimens used by Inger, but that for *hazelae* is now large (100+), representing several areas on Negros and Masbate Islands.

Our analysis, using several proportional characters in addition to the characters cited by Inger, supports his view of probable relationships. We also treat *polilloensis* as a distinct species and *rivularis* as a possible synonym of *hazelae*, although with reservation. We need larger samples from northern Luzon and Polillo Islands. It is

doubtful that this isolated montane population (*rivularis*) in the northern mountains of Luzon is conspecific with *hazela* in the central islands.

DESCRIPTION. — SVL 21.6–28.1 mm for 20 males and 26.2–34.8 mm for 20 females; HW 104–111% of HL and 36–43% of SVL; snout pointed, sometimes terminating in a pointed knob, most evident in ventral view; upper jaw moderately to strongly protruding; SnL 35–44% of HL and 35–43% of HW; ED 75–94% of SnL and 26–37% of HW; tympanum distinct, TD 25–42% of ED; canthus sharply rounded; lores moderately oblique, concave; vomerine teeth faint, low, in small patches or absent; fingers without or with minute basal web; first finger shorter than second, reaching beyond tubercle or midpoint between tubercle and disk of second finger when adpressed; fingers (except first) with broad, somewhat truncate disks marked by a circummarginal groove; transverse, basal groove absent; 3FD 35–45% of 3FL and 142–225% of TD; subarticular tubercles large, rounded, moderately protruding; one row of supernumerary tubercles; inner metacarpal tubercle elongate, middle one large, oval, and outer small; hind limb long; TiL 46–52% of SVL and HW 72–86% of TiL; toes webbed to middle or distal edge of tubercle on first and second toes, to distal edge of basal tubercle on third, and about midway between tubercles on fifth; disks of toes smaller than those of fingers, rounded; 3ToD 54–78% of 3FD; subarticular tubercles rounded, low; plantar area with very small, scattered tubercles; inner metatarsal tubercle elongate, outer small, round or vague; dorsum nearly smooth or with a few scattered tubercles; belly and posterior thighs covered with coarse granules; throat nearly smooth or with finer granules.

COLOR. — In preservative, dorsal background color light to dark brown or reddish brown, nearly uniform or usually with some darker spots or blotches (25 of 36 specimens in sample); upper lateral surfaces of similar color or somewhat lighter; nearly always a distinct interorbital color-break (darker posteriorly and lighter anteriorly); dorsal and upper lateral surfaces more pinkish or creamy gray (five of 36 specimens); a broad, pale dorsum with upper lateral surfaces darker (five of 36 specimens); a pale vertebral stripe (one of 36 specimens); lips usually with vague dark bars; hind limbs usually with vague, transverse, dark bars; venter with brown flecks

or spots, most dense anteriorly, rarely nearly uniform grayish cream.

In life, background color of dorsum highly variable, ranging from grayish tan through pale brown and reddish brown to blackish brown, usually with darker spots and blotches but also nearly uniform, sometimes with a narrow, vertebral streak or broad band extending from the tip of the snout to the posterior end of the body; hind limbs with vague or prominent, transverse dark markings; venter creamy, usually flecked or blotched with brown.

REPRODUCTION. — Clutches of eggs of this species have been found in arboreal ferns and leaf axils of *Pandanus*. The eggs are large, unpigmented, and the observed clutch size is five to nine. Developmental mode is direct and the developmental period is 49+ days (for details see Alcala, 1962).

COMPARISONS. — See *Platymantis cornutus* for comparison with that species. *Platymantis hazela* differs from the remaining species other than *polilloensis* in the absence of brown and yellow areolations in the groin, on the thighs, and sometimes on the lower legs and on the venter. Since the small sample available for *rivularis* does not differ significantly from *hazela* in any of the ratios tested, we continue to treat it, as did Inger, as possibly an isolated population of *hazela*, although with reservations.

ECOLOGICAL NOTE. — *Platymantis hazela* occupies primarily arboreal ferns and leaf axils of *Pandanus* in the submontane and montane forests above 1000 m in the mountains of Negros Island. There are a few records from gabi (Araceae) shrubs and even rocks in streams on Mount Canlaon. Also there are a few records from dipterocarp forest between 250 and 600 m on Cuernos de Negros or adjacent mountains (Brown and Alcala, 1961). In one project at Lake Balingsasayo, 65 specimens were taken from arboreal ferns, ranging from 2.5 to 24 m above the forest floor.

RANGE. — Recorded from Negros and Masbate islands.

Platymantis polilloensis (Taylor)

Philautus polilloensis Taylor, 1922a:171 (Type loc.: near town of Polillo, Polillo Island; holotype in CAS)

DESCRIPTION. — SVL 20.2–22.1 mm for two males and 25.5 mm for one female; HW 99–105% of HL and 38–41% of SVL; snout round pointed, upper jaw strongly protruding; SnL 42–43% of HL and 40–43% of HW; ED 76–86% of SnL and 31–34% of HW; tympanum distinct, TD 19–40% of ED; canthus sharply rounded; lores moderately oblique, concave; vomerine teeth in small, low patches; fingers without distinct webs; first finger reaching just beyond tubercle of second finger; disks of fingers (except first) broadly dilated, somewhat truncate; 3FD 33–40% of 3FL and 144–200% of TD; subarticular tubercles large, round, low; one row of supernumerary tubercles; inner metacarpal tubercle oval; middle and outer indistinct; hind limb long; TiL 52–53% of SVL and HW 71–79% of TiL; toes webbed to middle of tubercle on first and second fingers, just beyond basal tubercle on third, and midway between tubercles on fifth; 3ToD 50–62% of 3FD; subarticular tubercles rounded, low; plantar surface smooth; inner metatarsal tubercle elongate; outer vague; dorsum nearly smooth; belly and posterior thighs with flat granules.

COLOR. — In preservative, dorsal background color grayish tan with darker flecks and spots (greatly faded); venter grayish cream with a few dark flecks under head and throat.

In life, "Above creamy white to yellow, slightly pigmented with minute dots of cinnamon brown; a bar of cinnamon between eyes and dim spots about the dorsal tubercles; upper eyelids dark gray to blackish; spots on outer digits of all limbs; dim bars on tibia and femur; chin and throat yellow with very sparse peppering of brown; underside of hand and belly immaculate; underside of leg and foot strongly peppered with brown" (Taylor 1922a).

REPRODUCTION. — No information is available.

COMPARISONS. — For comparison with *P. cornutus* see that species. *Platymantis polilloensis* differs from *hazelae*, as indicated by Inger, in the possibly smaller size at maturity (Table 1), the difference in means for SnL/HW (*hazelae* mean = 39.00, SD = 2.285, n = 20; *polilloensis* mean = 42.33, SD = 0.577, n = 3; t = 2.466, df = 20, p = 0.023). It differs from the remaining species of the *hazelae* Group, as did *hazelae*, in the absence of yellow and brown areolations in the groin and on the hind limbs and venter.

ECOLOGICAL NOTE. — The specimens were found under and among the leaves of low growing plants along a forest trail (Taylor, 1922a).

RANGE. — Known only from Polillo Island.

Platymantis subterrestris

Cornufer subterrestris Taylor, 1922b:275 (Type loc.: Mountain Province, Luzon Island, Philippines)

Of the five species characterized by the yellow and brown areolations in the color, *Platymantis subterrestris* was the first one described, and this on the basis of a unique specimen. Only two additional specimens are known.

DESCRIPTION. — SVL 24.1 and 25.1 mm for two males, 27.6 mm for one female (two apparently immature specimens measure 19.9 and 22.1 mm); HW 110–114% of HL and 38–42% of SVL; snout broadly rounded; SnL 38–42% of HL and 32–35% of HW; ED 73–79% of SnL and 22–24% of HW; tympanum distinct, TD 42–52% of ED; canthus rounded; lores oblique, shallowly concave; fingers without webs or basal one between second and third and third and fourth; tips of fingers dilated into moderately large, slightly rounded disks, moderately broader than subtending phalange (except for first finger); 3FD 19–31% of 3FL and 80–89% of TD; subarticular tubercles large, rounded; row of supernumerary tubercles low and barely evident; inner metatarsal tubercle large, elongate; outer vaguely evident for one specimen; hind limbs moderately long; TiL 42–47% of SVL and HW 88–91% of TiL; toes webbed at base: to proximal edge or middle of tubercle on second, third, and fifth toes; disks of toes smaller than those of fingers; 3 ToD 56–75% of 3FD; subarticular tubercles moderate, low; plantar area smooth; inner metatarsal tubercle low, elongate; outer not clearly evident in present state of preservation; dorsum without distinct tubercles but with two or three narrow ridges of varying length (unless these result from preservation); belly region with vague, flattish granules.

COLOR. — In preservative, middorsal area and head brownish with some pale blotches; upper lateral surfaces grayish tan to brownish; lower lateral surfaces, especially in groin with pale areolations (yellow in life); thighs similarly marked; venter dusky, cream, or brownish under head and throat with a few brown spots or

TABLE 1. Snout-vent length (SVL) and color pattern for the *hazela* Group species of Philippine *Platymantis* (N = number in sample, \bar{x} = mean, F = female, M = male).

Species	N	SVL of Adults		Yellow and Brown Areolations Present
		Range	\bar{x}	
<i>P. cornutus</i>				
F	0			
M	1	30		
<i>P. hazela</i>				
F	20	26.2–34.8	31.2	
M	21	21.6–28.8	26.0	
<i>P. polilloensis</i>				
F	1	25.5		
M	2	20.2–22.1		
<i>P. lawtoni</i>				
F	2	39.0–39.2		X
M	1	31.5		X
<i>P. montanus</i>				
F	5	26.0–28.5	27.6	X
M	8	23.9–27.7	26.1	X
<i>P. panayensis</i>				
F	7	28.4–32.2	29.9	X
M	7	25.4–28.0	27.5	X
<i>P. reticulatus</i>				
F	5	28.4–30.2	29.2	X
M	7	23.3–27.7	25.0	X
<i>P. subterrestris</i>				
F	1	27.6		X
M	2	24.1–25.1		X

blotches on belly. In life (after Taylor, 1922b), "Above purplish without markings on head; sides dark purplish brown with large rounding spots of cream to yellow, more prominent on groin and axilla; upper parts of limbs purplish; on sides and below with large, cream-yellow, irregular spots; throat dusky; belly dusky, reticulated with cream."

REPRODUCTION. — No information is available for this species.

COMPARISONS. — Differs from the other species included in this study primarily in the

smaller finger disks and resulting proportional characters, (3FD 80–89% of TD and 19–31% of 3FL). Other species have third finger disks larger than the tympanum (3FD 118–220% of TD and 3FD 29–48% of 3FL). The eye is also smaller relative to head breadth (Table 2).

ECOLOGICAL NOTE. — The type specimen was collected on a mossy stream bank along a mountain trail in the forest.

RANGE. — Recorded only from the mountains of northern Luzon.

TABLE 2. Comparison of body proportions (in %) of four species of the *hazelae* Group that exhibit the yellow and brown areolations (\bar{X} = mean, N = number in sample).

Species	TiL/SVL	ED/HW	3FD/3FL	3FD/TD
<i>P. montanus</i>				
Range	47-53	25-31	30-40	118-200
\bar{X}	51	28	35	154
N	13	13	12	13
<i>P. panayensis</i>				
Range	50-55	30-37	32-44	127-220
\bar{X}	52	34	37	165
N	14	14	13	12
<i>P. reticulatus</i>				
Range	47-53	27-33	32-42	125-180
\bar{X}	50	29	38	146
N	10	11	11	11
<i>P. subterrestris</i>				
Range	42-47	22-24	19-31	80-89
\bar{X}	45	23	26	84
N	3	3	3	3

Platymantis montanus (Taylor)

Fig. 2

Cornufer montanus Taylor, 1922b:272 (Type loc.: Mount Banahao, Laguna Prov., Luzon; holotype in CAS).

Inger (1954) placed *montanus* in the synonymy of *subterrestris*, having seen only four specimens: the type of *montanus* from Mt. Banahao in southwestern Luzon and the type of *subterrestris* along with two other specimens from the mountains of northern Luzon. He based his decision on general similarities: moderate to large digital disks, size at maturity, and pale and brown areolations in the groin and on the hind limbs. The availability of 13 more specimens from Mt. Banahao and three specimens from the Zambales mountains in western Luzon, that are in agreement with the type of *montanus* clearly differentiate this species from *subterrestris*. The finger disks are larger relative to 3FL or TP, and the eye is smaller relative to the head width

(Table 2). Based on these differences, we resurrect *montanus* as a valid species.

DESCRIPTION. — SVL 23.9–27.7 mm for eight males and 26.0–28.5 mm for five females (two specimens measuring 21.9 and 22.9 mm are apparently immature); HW 105–121% of HL and 38–42% of SVL; snout broadly rounded, upper jaw scarcely protruding; SnL 33–42% of HL and 31–37% of HW; ED 76–94% of SnL and 25–31% of HW; tympanum distinct, TD 31–48% of ED; canthus rounded; lores oblique, concave; vomerine teeth in very low patches or absent; fingers without webs or occasionally as minute one at base; first finger much shorter than second, reaching just beyond tubercle; 3FD 30–40% of 3FL and 118–200% of TD; subarticular tubercles large, round, only moderately protruding; one row of prominent supernumerary tubercles; inner and middle metatarsal tubercles large, low, oval; outer small, low or scarcely evident; hind limbs moderately long, TiL 47–53% of SVL (only two examples below 50%) and HW 76–84% of TiL;



FIGURE 2. *Platymantis montanus* from Zambales Mountains, Luzon. Photo by D. Wechsler.

toes webbed: to middle of basal tubercle on inside of first and second fingers, distal edge of basal tubercle on third, and between tubercles on fifth; disks of toes smaller than those of fingers, 3ToD 42–73% of 3FD; subarticular tubercles moderately projecting; plantar surface smooth; inner metatarsal tubercle low, elongate; outer not evident; dorsum without tubercles or ridges; belly with vague, large, flat granules; smaller and more prominent granules on posterior surface of thighs.

COLOR. — In preservative, dorsal background color grayish, tannish with darker blotches; one specimen with a dark, mid-dorsal region, two with a narrow, pale, vertebral stripe; groin area with pale (yellow in life) areolations; anterior and posterior thighs usually similarly patterned; venter dusky white to creamy with brown spots and blotches, most prominent under head and throat.

In life, above gray-brown, variegated, with a broad median cream yellow stripe from tip of snout to anus; bars on legs dull cream to white; side and groin with large, bright, lemon yellow spots, separated by narrow lines of brown; belly and chin pinkish tan, mottled with brown; under-

side of limbs with large island like white or yellow spots; toes barred with cream; a narrow indistinct line from eye across tympanum and angle of mouth. Loreal region dark brown, mottled slightly with lighter.

REPRODUCTION. — One female had several unpigmented, nearly fully-developed eggs in each ovary.

COMPARISONS. — For comparisons with *cornutus*, *hazelae*, and *polilloensis* see those species. As noted in the introductory comments on this species, it differs from *subterrestris* primarily in its larger finger disks, as evidenced by the ratios of 3FD/3FL, 3FD/TD, and the larger eye relative to snout length or head width (Table 2). *Platymantis montanus* differs from *lawtoni* in its smaller size at maturity (Table 1).

ECOLOGICAL NOTE. — The type specimen is from a shrub on the face of a cliff at an elevation of about 1500 m on Mount Banahao (Taylor 1922b). The other specimens from Mt. Banahao are from shrubs, tree ferns, and *Pandanus*. Two of the three Zambales specimens were collected from the interior of a wet rotting log and one from beneath a rock in a dry stream bed on the forested slopes of Mount Apoy at elevations of about

1500 and 1600 m respectively. This mountain in the Zambales Range was heavily impacted by the Mount Pinatubo eruption in 1991 (Rafe Brown and Angel Alcala, pers. observ.), and, at the time of the collections (1993), the ground and much of the vegetation such as the arboreal ferns still had a covering of ashes 2–4 cm in thickness. These conditions may have been related to the unexpected microhabitat of these frogs (R. Brown et al., in press). One lizard species, *Sphenomorphus beyeri* also exhibits the same disjunct distributions (Brown, Ferner, and Sison, 1995).

RANGE. — Recorded only from Mount Banahao and Mount Apoy in southwestern Luzon.

Platymantis lawtoni Brown and Alcala

Platymantis lawtoni Brown and Alcala, 1974: 2; (Type loc.: Tablas Island, Philippines; holotype in CAS)

The following description is based on three adult specimens and five juveniles, except for proportions which are based on the adults.

DESCRIPTION. — SVL 31.2 mm for one male and 39.0–39.2 mm for two females (a female measuring 26.1 mm is immature); HW 107–116% of HL and 35–41% of SVL; snout rounded to round pointed; upper jaw usually moderately protruding; SnL 37–42% of HL and 36–39% of HW, ED 76–83% of SnL and 29–30% of HW; tympanum exposed, TD 28–38% of ED; canthus rounded; lores moderately oblique, concave; vomerine teeth in prominent, oblique patches; fingers not or only webbed at base; first finger much shorter than second; fingers (except first) with large, somewhat truncate disks; 3FD 35–45% of 3FL and 130–200% of TD; subarticular tubercles large and moderately protruding; one row of supernumerary tubercles; inner metacarpal tubercle elongate, outer rounded; hind limb long; TiL 48–55% of SVL and HW 72–86% of TiL; toes partially webbed: to midpoint or distal edge of subarticular tubercle on inside of first and second toes, to slightly beyond basal tubercle or midpoint between tubercles on third, and between tubercles on fifth; 3ToD 76–79% of 3FD; subarticular tubercles rounded, slightly protruding; plantar area smooth; inner metatarsal tubercle elongate; outer small, round; dorsal surfaces relatively smooth; belly with moderate flat granules; throat smooth.

COLOR. — In preservative, dorsum grayish tan to reddish brown with few to numerous dark brown spots and blotches or with middorsal brown band; groin area and posterior thighs with large, pale (yellowish in life) areolations; venter with dark flecks, especially on chin and throat; these flecks occasionally occur in clusters.

REPRODUCTION. — The large, unpigmented eggs (2.0 mm) are characteristic of other species of the genus and indicate a direct development mode.

COMPARISONS. — *Platymantis lawtoni* is the largest species of the *hazela* Group with the possible exception of *P. cornutus* (Table 1). The SVL of 31.5 mm for the male and 39.0 and 39.2 mm for the two females is greater than the maximum for any of the other species.

ECOLOGICAL NOTE. — The holotype and paratype are from leaf axils of gabi (Araceae) plants at elevations 200–250 m in forest on Mount Progreso. The specimens from Sibuyan Island are from the forested slopes of Mt. Guitinsuitan.

RANGE. — Recorded from Tablas and Sibuyan islands.

Platymantis panayensis new species

This species shares with *lawtoni*, *reticulatus*, *montanus*, and *subterrestris* the pale (bright yellow in life) areolations in the groin and on the hind limbs. This feature of the color pattern is one of the characteristics that differentiates it from *hazela*, the species that occupies the nearby island of Negros. This is the only large-disked species of either the *hazela* or *guentheri* Groups thus far recorded from Panay Island and cannot be confused with any other species there.

Holotype. — PNM 2495, an adult female, northwest ridge approach to Mt. Madja-as (about 1410 m), Libacao, Aklan Prov., Panay Island, April 21, 1992, R. M. Brown and party.

Paratypes. — Aklan Prov., Nabas: CAS 137641–42, Mt. Madja-as: CMNH 4113–15, PNM 2314–16; Antique Prov., Culasi; Mt. Madja-as: CMNH 4116–18, 4120, PNM 2317–20.

Description of Holotype. — SVL 28.5 mm, HL 10.6 mm, HW 11.2 mm, SnL 3.8 mm, ED 2.4 mm, TD 1.15 mm, TiL 16.0 mm, 3FL 5.1 mm, 3FD 1.8 mm, 3ToD 1.2 mm. Dorsum grayish tan and dark brown, mottled pattern with the dark

brown predominant; venter with prominent dark brown spots.

DIAGNOSIS. — Differs from other species of *Platymantis* in the following combination of characters: (1) bright yellow (in life) and brown areolations in the groin and on the anterior and posterior surfaces of the thighs; (2) size small, about 25–28 mm SVL for males and 28–32 mm for females; (3) HW 70–80% of TiL and TiL 50–56% of SVL; (4) ED 32–37% of HW; (5) toes with small webs: to proximal or distal edge of tubercle for first and second toes, to about distal edge of tubercle for third, and to nearly midpoint between tubercles for fifth toe.

DESCRIPTION. — SVL 25.4–28.0 mm for seven males and 28.4–32.2 mm for seven females; HW 103–111% of HL and 36–39% of SVL; snout rounded, not distinctly pointed; upper jaw slightly to moderately protruding; SnL 35–42% of HL and 32–40% of HW; eye large, ED 77–93% of SnL and 30–37% of HW; tympanum distinct, TD 23–40% of ED; canthus sharply rounded; lores moderately oblique, concave; vomerine teeth not evident except for low, oblique patches for a couple of specimens; fingers without or at most with a minute web at base; first finger much shorter than second, reaching slightly beyond tubercle to about midway between tubercle and disk of second finger; fingers, except first, with large, truncate disks; 3FD 32–44% of 3FL and 127–220% of TD; subarticular tubercles large rounded, low; inner metacarpal tubercle not clearly evident; outer usually distinct, low somewhat elongate; one row of moderately large, flatish supernumerary tubercles; hind limbs long; TiL 50–55% of SVL and HW 71–80% TiL; toes webbed: to middle or distal edge of subarticular tubercle on first finger to tubercle on inside of second, to distal edge on inside of third, short of basal tubercle on fourth, and midway between tubercles on fifth; diameter of 3ToD 50–74% of 3FD; subarticular tubercles large, rounded to slightly elongate, low; supernumerary and plantar tubercles not evident; inner metatarsal tubercle elongate; outer small and round or not evident; dorsal surfaces finely shagreened without tubercles or ridges except for small tubercle on eyelid for two specimens; belly with large, flat granules.

COLOR. — In preservative, dorsal background color grayish to grayish tan lightly to heavily mottled with reddish brown to dark brown,

sometimes with a narrow or broad, pale vertebral stripe; hind limbs with vague to prominent light and dark transverse bands; pale, brown-bordered areolations in the groin and on the thighs; venter ivory cream, nearly uniform, or variably mottled with dark flecks and spots.

In life, dorsal ground color corn yellow to yellowish brown with dark brown to black spots, irregular bars, or occasionally a middorsal stripe; lateral surfaces with golden yellow or orangish yellow round spots, particularly in groin region; milky white to cream or sometimes pale blue on throat.

REPRODUCTION. — Two clutches of embryos (numbering three and six) were collected from leaf axils of a palm and a *Pandanus*, one accompanied by an adult frog. A third clutch of three embryos was found on the underside of a frond of an arboreal fern. Eggs are unpigmented and one measured 3.4 mm in diameter. The clutch from the *Pandanus* included three egg capsules containing froglets in an advanced stage of direct development. All digits on both fore and hind limbs are well-developed, and the tail ranges from nearly maximum length for one specimen to about two-thirds absorbed for another. These are nearly fully-developed (see Alcala, 1962).

ETYMOLOGY. — The name is derived from that of the island where the species occurs.

COMPARISONS. — *Platymantis panayensis* is one of five species exhibiting the pale (yellow in life), brown-bordered areolations in the groin and on the hind limbs, differing in this feature of the color pattern from *cornutus*, *hazela*, and *polilloensis*. It also differs from *hazela* in the longer tibia relative to SVL (*hazela* mean = 49.579, SD = 2.341, n = 19; *panayensis* mean = 52.308, SD = 1.797, n = 13; $t = 3.542$, $df = 30$, $p = 0.001$).

For those species which share the color feature of brown and yellow areolations, *Platymantis panayensis* differs from *subterrestris* in the larger finger disks as evidenced in several ratios (Table 2). It differs from *lawtoni* in the smaller size at maturity and from *montanus* in the slightly larger size (Table 1), in the difference between the means for TiL/SVL (*panayensis* mean = 52.352, SD = 1.737, n = 14; *montanus* mean = 50.923, SD = 1.605, n = 13; $t = 2.223$, $df = 25$, $p = 0.035$), and in ED/HW (*panayensis* mean = 33.714, SD = 2.30, n = 14; *montanus* mean = 28.385, SD = 1.805, n = 13; $t = 3.291$, $df = 13$, $p = 0.000$).

ECOLOGICAL NOTE. — All of the specimens are from forests in mountain areas: Nabas 750 m elevation, Mt Madja-as area 1400–1450 m, and Culasi 1000–1050 m. As to microhabitat, five specimens are from leaf axils of *Pandanus*, three from arboreal ferns, one from a palm leaf, three on leaves of shrubs, and two on duff on the forest floor. While the advertisement call of the new species was not recorded, animals were observed (by RMB) calling from shrub-layer vegetation on Mt. Madja-as at 1400 m. The call is similar to the sound made by a small brass bell and is issued repetitively following rains or heavy fog coverage.

RANGE. — Known only from Aklan and Antique provinces on the western side of Panay Island.

***Platymantis reticulatus* new species**

Fig. 3

The first examples of this species were three specimens collected by D. S. Rabor in 1961. At the time, they were identified as *Cornufer* (= *Platymantis*) *subterrestris*, based on the shared character, yellow and brown areolations on the groin and thighs and the similar size at maturity. The results of our study show that this Mt. Isarog population differs in several character states from the population in northern Luzon to which the name *subterrestris* applies.

Holotype. — CAS 197218, an adult male, Mt. Isarog (1200–1300 m), Camarines Peninsula, southeastern Luzon Island, collected Nov. 3–5, 1994, by Ely Alcala.

Paratypes. — CAS 21837; USNM 318277, 318300–06, FMNH 251633–40, from the same mountain as the holotype.

Description of Holotype. — SVL 23.5 mm; HL 8.2 mm; HW 9.2 mm; SnL 3.2 mm; ED 2.2 mm; TD 1.0 mm; TiL 12.2 mm; 3FL 4.1 mm; 3FD 1.3 mm; 3ToD 0.9 mm. Dorsal ground color is rather grayish with a dorsolateral row of blackish brown spots beginning at the posterior corner of the eye; a very narrow, pale, vertebral line, bordered by vague, irregular, slate-colored blotches and scattered dark spots. The groin, thighs and lower legs are covered with pale, brown-bordered areolations. The venter has a network pattern of brown lines.

DIAGNOSIS. — Differs from other species of *Platymantis* in the following combination of

characters: (1) the usually more extensive yellow and brown areolations, extending onto the lower hind limbs as well as the groin area and thighs and the frequent reticulate pattern of brown lines on the venter; (2) SVL at maturity less than 28 mm for males and 31 mm for females; (3) the typical pattern of small, dark spots on the dorsum and usually a reticulum of brown lines on the venter; and (4) several proportional measurements that separate it from other individual species of this Group (see **COMPARISONS**).

DESCRIPTION. — SVL 23.3–27.7 mm for seven males and 28.4–30.2 mm for five females; HW 106–114% of HL and 37–43% of SVL; snout broadly rounded, upper jaw scarcely protruding; SnL 36–39% of HL and 32–37% of HW; ED 76–91% of SnL and 27–33% (only three of 13 examples above 29%) of HW; tympanum distinct, TD 35–52% of ED; canthus rounded; lores strongly oblique, concave; vomerine teeth rarely present or sometimes in a low patch; fingers without webs; first finger much shorter than second, reaching only slightly beyond the tubercle of the second when adpressed; 3FD 32–42% of 3FL and 125–180% of TD; subarticular tubercles large, rounded, only moderately projecting; one row of supernumerary tubercles or indistinct; inner metacarpal tubercle low, somewhat elongate; outer rarely evident; hind limbs moderately long, TiL 47–53% of SVL (rarely greater than 50%) and HW 75–86% of TiL; toes webbed: to midpoint or distal edge of tubercle on inside of first, second and third toes and midway between tubercles on fifth; disks of toes smaller than those of fingers, 3ToD 50–88% of 3FD (only two immature specimens above 70); subarticular tubercles large, round, moderately protruding; no supernumerary tubercles; inner metacarpal tubercle elongate; outer small, round, or not evident; projecting tubercle at distal end of tibia; dorsum without prominent tubercles or ridges; lateral surfaces with some tubercles; belly with large, flat granules; throat relatively smooth or with small granules.

COLOR. — In preservative, dorsum grayish tan to tan, mottled with dark (usually brown), small spots and sometimes larger blotches; groin area and usually both thighs and lower legs with pale, brown-bordered areolations; venter pale cream, with a reticulum of brown lines or scattered brown spots.



a



b

FIGURE 3. *Platymantis reticulatus* from Mt. Isorog, Luzon: a. dorsal view and b. ventral view.

In life, dorsal background color grayish to orange brown, marked with varied darker spots and blotches; a pale vertebral line, beginning on snout for some specimens; dark transverse bars on hind limbs; yellowish, brown-ringed areolations in groin, on thighs, and frequently the lower legs; venter with brown spots or reticulations.

REPRODUCTION. — Eggs of gravid females are large and unpigmented, five in one ovary of one female. Deposition sites and development remain unknown.

ETYMOLOGY. — The name refers to the net-like pattern resulting from the brown lines on the belly for some specimens and the areolations on the hind limbs.

COMPARISONS. — *Platymantis reticulatus* differs from *cornutus*, *hazelae*, and *polilloensis* in the pale, brown-bordered areolations present in the groin and on the hind limbs and the brown reticulum on the venter.

For those species that share the brown and yellow areolations, *Platymantis reticulatus* differs in their expansion on the lower legs and reticulate ventral pattern. It also differs from *subterrestris* in its larger finger disks and the resultant proportional differences (Table 2); from *lawtoni* in its smaller size at maturity (Table 1); and from *montanus* in the color pattern; and from *panayensis* in the means for ED/HW (*reticulatus* mean = 29.091, SD = 1.921, n = 11; *panayensis* mean = 33.714, SD = 2.301, n = 14; $t = 6.660$, $df = 25$, $p < 0.001$); and TiL/SVL (*reticulatus* mean = 50.200, SD = 1.687, n = 10; *panayensis* mean = 52.352, SD = 1.737, n = 14; $t = 3.035$, $df = 22$, $p = 0.006$).

ECOLOGICAL NOTE. — Specimens were collected in submontane and montane forest on Mount Isarog at elevations of about 1100–1500 m. Two specimens were from birdnest ferns, three on branches and trunks of trees, and one on the forest floor.

RANGE. — Known only from Mount Isarog in southeastern Luzon Island.

DISCUSSION

The eight species included here are, with the exception of *hazelae*, poorly known. *Platymantis panayensis* is known from 17 specimens, *reticulatus* from 18, *montanus* from 15, *lawtoni* from five, *subterrestris* from three, *polilloensis* from three, and *cornutus* from one. They are, however,

assumed to be a natural assemblage, with the probable exception of *Platymantis cornutus*. The remaining seven species share not only the primary digital characters that are diagnostic of the group, but also are small to moderate in size with modest sexual dimorphism (Table 1). Five of the seven share a particular color feature, variable yellow and brown-bordered areolations in the groin, on the thighs, and sometimes the lower legs. These five species differ in combinations of other character states: (1) small, but relatively consistent differences in various features of the color pattern, (2) some differences in size at maturity, (3) shape of snout, (4) size of eye, tympanum, or digital disks, (5) length of hind limbs, as measured by tibia length, (6) various proportional measurements (Table 2).

Known populations are restricted to forest habitats, primarily montane and submontane. *Platymantis hazelae*, for example, is abundant in forests above 1000 m but rare at lower elevations on Cuernos de Negros and Mt. Canlaon, both on Negros Island. Other species from several mountain areas of Luzon and the mountains in western Panay are also recorded at elevations ranging from about 900 to 1700 m. *Platymantis lawtoni* is recorded from Mt. Progreso on Tablas Island at an elevation of 200–250 m, but this mountain is only about 1000 m high. Most specimens have been found in arboreal ferns, leaf axils of *Pandanus*, or similar microhabitats, and rarely on low shrubs or the surface stratum. This Group of species is also limited to islands of the Greater Negros and Greater Luzon regions (Fig. 4). Thus far no species of this Group has been recorded from Mindoro Island, although *Platymantis lawtoni* occurs on the nearby island of Tablas.

Two different isolating mechanisms have operated in producing the differentiation evidenced by the populations. The populations on Negros, Panay, Sibuyan, and Tablas have been isolated from each other, as well as from those on Luzon, by marine barriers for varying periods of time. A land connection between Negros and Panay presumably existed as recently as 18,000–20,000 years BP during the lowered sea level of that period; but possible land connections involving Luzon and/or Sibuyan and Tablas would have necessitated even lower sea levels. Such conditions may have occurred at times earlier, mid-Pleistocene about 100,000 to 500,000 years BP (Morley and Flenley, 1987). The isolating

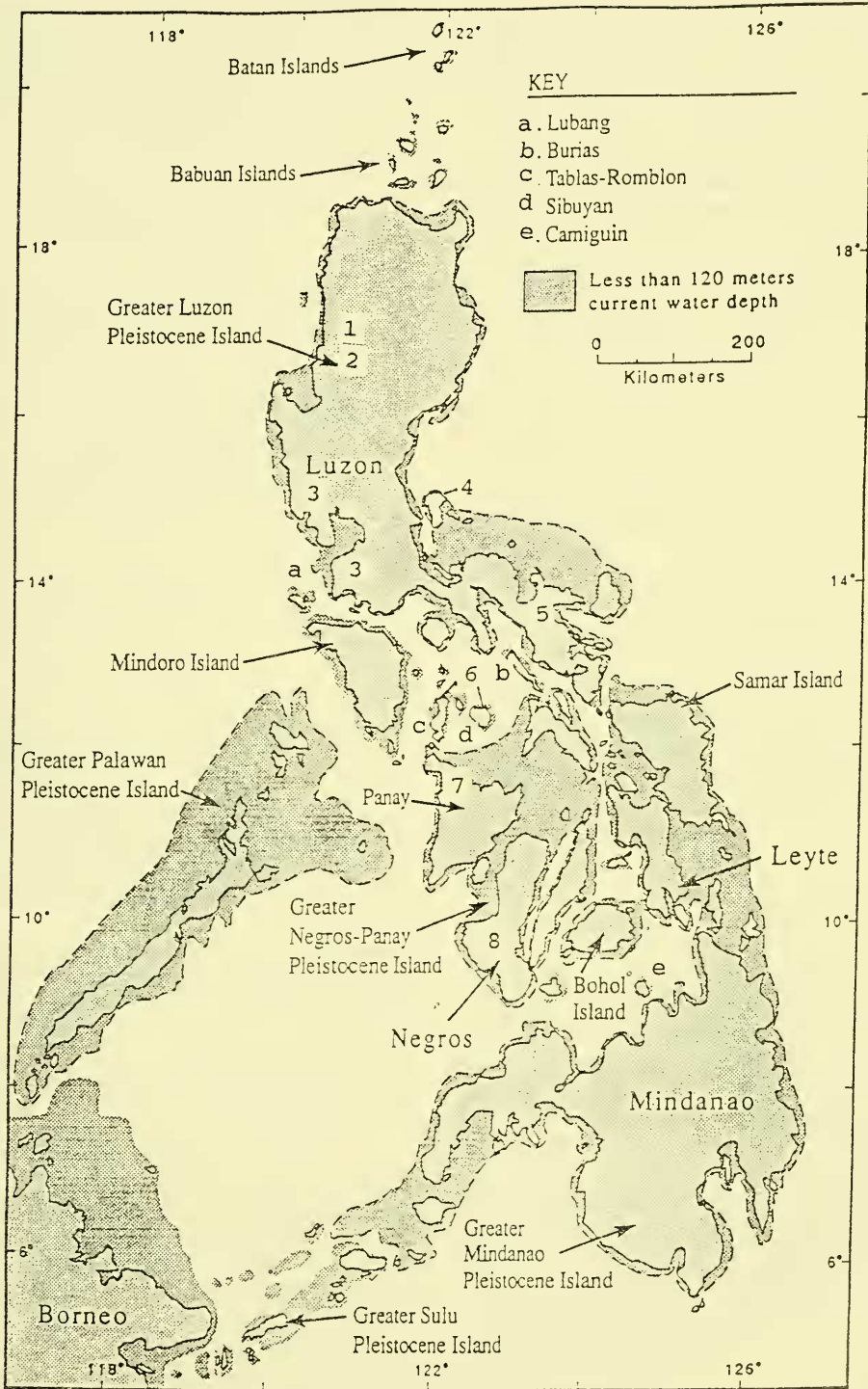


FIGURE 4. Distribution of hazelae Group species in central and northern Philippine Islands: (1) *Platymantis subterrestris*, (2) *Platymantis cornutus*, (3) *Platymantis montanus*, (4) *Platymantis polilloensis*, (5) *Platymantis reticulatus*, (6) *Platymantis lawtoni*, (7) *Platymantis panayensis*, (8) *Platymantis hazelae*.

mechanism operating for the Luzon populations is the montane habitat preference of the frogs on isolated mountain or volcanoes (Mount Isarog). These are separated by lowland forest or man-made habitats.

These montane, tropical forest refugia were maintained throughout the alternating sea-level fluctuations, since there is no evidence of dramatic changes in local climates such as occurred in temperate mountains. It is estimated that sea and lowland surface temperatures in such tropical areas as Sunda, New Guinea, and the Philippine Islands were no more than two to three degrees centigrade below its present level (Walker, 1981). Tropical forests were narrower in terms of its north-south limits, and the width of the lowland, submontane, and montane zones on the mountains was reduced in breadth (Whitmore, 1981). It is also assumed that rainfall was reduced in some areas.

Similar patterns of montane endemism are known not only for amphibians but also reptiles, mammals, and even birds on other large islands in the Philippines, Borneo, New Guinea, Solomon Islands, and Fiji. For some examples see Brown (1991, 1995), Brown and Gibbons (1986), Diamond (1985), Inger and Stuebing (1992), Leviton and Brown (1959), Heaney and Rickart (1990), Rickart, Heaney, and Utzurum (1991).

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APPENDIX A Specimens Examined

For brevity, only general locality, island names, and museum numbers are provided. Precise locality and other data are available from museum catalogs.

Platymantis cornutus. — Luzon I., Mountain Province: CAS 61476 (holotype).

Platymantis hazelae. — Luzon I., Mt. Canlaon area: CAS-SU 16615-28, 23458-63, 2346, 23470, 23526, 23538-59, 23560-627, 63712-17, 23723-31, 23736-37, 23741-79, CAS 139264-73, 185870-76; southern Negros I.: CAS-SU 16615-28, 18157, 18436-38, 18440-43, 18446-48, 18488-92, 18494-95, 13619-24, 18528, 18717-26, 19010, 19442, 19461, 19497, 19499, 19838-40, CAS 89806-07, 128916-18, 128920, 133912-14, 133946-54, 134231-34, 137429-495, 138197-98, 139262-63, 145225-43, 145893-94, 147292-94, 185445-49, 185827, 185844-69, 185870-76, 185939-48; Luzon I.: CAS 61477 (holotype of *Cornufer rivularis*), CAS 61478 and MCZ 14386 (paratypes of *C. rivularis*).

Platymantis polilloensis. — Polillo I.: CAS 62250 (holotype), CAS 62251-52 and MCZ 14469-72 (paratypes).

Platymantis lawtoni. — Tablas I.: CAS 135732 (holotype), CAS 135733 (paratype); Sibuyan I.: FMNH 236092, 236096, 236142, 236146, 249701.

Platymantis montanus. — Luzon I., Mt. Banao: CAS 61179 (holotype), CAS 200998-201002, 201204, 201213-14, 201222-29, 201504-35, 202529, 202536-37, 202542-43, 202545; Zambales Prov.: CMNH 4112, PNM 2314-15.

Platymantis panayensis. — See holotype and paratypes for this species.

Platymantis reticulatus. — See holotype and paratypes for this species.

Platymantis subterrestris. — Luzon I., Mountain Prov.: CAS 61518 (holotype); MCZ 14387–88, FMNH 172392, 173165.

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